FORM PTO-1390 REV. 2/01 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 08432.0002

U.S. APPLICATION NO. (If known, see 37CFR1.5): 09/869031

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/06898	September 17, 1999	December 23, 1998

TITLE OF INVENTION: FIBRIN-BASED GLUE GRANULATE AND CORRESPONDING PRODUCTION METHOD

APPLICANT(S) FOR DO/EO/US: Mirna RAPP

Applicant(s) herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c)(2)).
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed with the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154 (d)(4).
7. ☐☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)).
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☒ Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A Substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154 (d)(4).
19. ☐ A second copy of the English language translation of the international application 35 U.S.C. 154 (d)(4).
20. ☒ Other items or information:
   a. ☒ Copy of cover page of International Publication No. WO00/38752.
   b. ☐ Copy of Notification of Missing Requirements.
   c. ☒ Copy of Certification of Translation.

U.S. APPLICATION NO. (If known, see 37CFR 1.5) 09/786931	INTERNATIONAL APPLICATION NO. PCT/EP99/06898 JC18 Rec'd PCT/PTO 22 JUN 2001	ATTORNEY'S DOCKET NUMBER 08432.0002

21. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1000.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33 (1)-(4) **$100.00**

CALCULATIONS PTO USE ONLY

ENTER APPROPRIATE BASIC FEE AMOUNT =				$860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				$	
CLAIMS	NUMBER FILED		NUMBER EXTRA	RATE	
Total Claims	47	- 20 =	27	x $18.00	$486.00
Independent Claims	1	-3 =	0	x $80.00	$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+$270.00	$270.00
TOTAL OF THE ABOVE CALCULATIONS =				$1616.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				$	
SUBTOTAL =				$1616.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				1616.00	
Fee for recording the enclosed assignment (37 CFR 1.21 (h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property. +				$	
TOTAL FEES ENCLOSED =				$1616.00	
				Amount to be refunded:	$
				charged:	$

a. ☒ A check in the amount of $ 1616.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-0916. A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING**: Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P
1300 I Street, N.W.
Washington, D.C. 20005-3315

DATED: June 22, 2001

RVS
Reg # 31,744
SIGNATURE
for Ernest F. Chapman. Reg. No. 25,961
NAME/REGISTRATION NO.

PATENT
Attorney Docket No. **08432.0002-00**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. National Phase of International Application PCT/EP99/06898	)	
Inventors: Mirna RAPP	)	
Application No.: Unassigned	)	Group Art Unit: Unassigned
Filed: Concurrently herewith	)	Examiner: Unassigned
For: FIBRIN ADHESIVE GRANULATE AND METHOD FOR ITS PREPARATION	)	

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Prior to the examination of the above application, please amend this application as follows:

IN THE CLAIMS:

Please cancel claims 1-24. Please add new claims 25-58 as follows:

25. A fibrin adhesive granulate comprising granulate pellets with a particle size in the range from approximately 50 µm to approximately 1000 µm, wherein said granulate pellets comprise thrombin, Factor XIII, fibrinogen, and a calcium salt.

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26. The fibrin adhesive granulate in accordance with claim 25, wherein the granulate pellets have a particle size in the range from approximately 100 µm to approximately 200 µm.

27. The fibrin adhesive granulate in accordance with claim 25, wherein said granulate pellets further comprise one or more substances chosen from albumin, fibronectin, or other substances that promote wound healing.

28. The fibrin adhesive granulate in accordance with claim 26, wherein said granulate pellets further comprise one or more substances chosen from albumin, fibronectin, or other substances that promote wound healing.

29. An effervescent preparation comprising a fibrin adhesive granulate as claimed in any one of claims 25 or 27 and substances required for the formation of CO_2, wherein the effervescent preparation generates a foam suitable for hemostasis.

30. The effervescent preparation in accordance with claim 29, wherein the substances required for the formation of CO_2 comprise a mixture of a carbonate and a physiologically safe organic acid.

31. A wound care fleece comprising a biodegradable support medium, wherein the biodegradable support medium comprises a fibrin adhesive granulate as claimed in any one of claims 25 or 27.

32. The wound care fleece in accordance with claim 31, wherein the wound care fleece comprises a hydrophilic, non-aqueous salve base, and wherein said salve base comprises the fibrin adhesive.

33. The wound care fleece in accordance with claim 31, wherein the biodegradable support medium comprises natural or chemically modified collagen, keratin, gelatin, carbohydrates or cellulose derivatives.

34. The wound care fleece in accordance with claim 31, wherein the biodegradable support medium comprises a polymer chosen from polyhydroxy carboxylic acids, polyesters, polycyano acrylates, polyamino acids, polyalcohols, or silicones.

35. The wound care fleece in accordance with claim 31, wherein said wound care fleece comprises fibrinogen in the range from approximately 0.05 mg/cm^2 to approximately 50 mg/cm^2 and thrombin in the range from approximately 1 µg/cm^2 to approximately 20 mg/cm^2.

36. The wound care fleece in accordance with claim 31, wherein the preparation containing the fibrin adhesive is applied to one or both sides of the support medium.

37. A preparation comprising a fibrin adhesive as claimed in any one of claims 25 or 27.

38. The preparation in accordance with claim 37, wherein said preparation comprises a wound care fleece, and wherein said wound care fleece comprises a biodegradable support medium comprising the fibrin adhesive.

39. The preparation in accordance with claim 37, wherein said preparation comprises a bandage, wherein said bandage comprises a wound care fleece, and wherein said wound care fleece comprises a biodegradable support medium comprising the fibrin adhesive.

40. The preparation in accordance with claim 37 wherein said preparation comprises a plaster, wherein said plaster comprises a water proof or water permeable material, and wherein said material comprises a wound care fleece, and wherein said wound care fleece comprises a biodegradable support medium comprising the fibrin adhesive.

41. A preparation comprising a wound care fleece as claimed in claim 32.

42. A preparation comprising a hydrophilic, non-aqueous salve base, wherein said salve base comprises a fibrin adhesive as claimed in claim 25.

43. A method for the preparation of a fibrin adhesive granulate as claimed in claim 25 comprising,

suspending the components of the fibrin adhesive in an organic solvent, and spray-drying said suspension to a granulate of particle size in the range from approximately 50 µm to approximately 1000 µm.

44. The method in accordance with claim 43, wherein the particle size of the granulate is in the range from approximately 100 µm to approximately 200 µm.

45. The method in accordance with claim 43, wherein the suspension is spray-dried onto a support medium.

46. The method in accordance with claim 44, wherein the suspension is spray-dried onto a support medium.

47. A method for the preparation of a fibrin adhesive as claimed in claim 25, comprising

preparing a fibrinogen granulate, and

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spraying an organic solvent comprising thrombin onto said fibrinogen granulate.

48. The method in accordance with claim 47, wherein a calcium salt is added to the fibrinogen granulate, to the thrombin solution, or to both the fibrinogen granulate and thrombin solution.

49. A method for the preparation of a fibrin adhesive granulate as claimed in claim 25, comprising

preparing separate fibrinogen and thrombin granulates, and
mixing the fibrinogen granulates with the thrombin granulates,
wherein both types of granulates have a particle size in the range from approximately 50 µm to approximately 1000 µm.

50. A method for preparing a preparation comprising layering a fibrin adhesive granulate as claimed in claim 25 on a biodegradable support medium.

51. A method for preparing the preparation as claimed in claim 42 comprising mixing the fibrin adhesive with the hydrophilic, non-aqueous salve base.

52. A method for preparing a preparation comprising adding other biological, vegetable or synthetic active substances to the fibrin adhesive granulate as claimed in claim 25.

53. The method in accordance with claim 51, wherein biological, vegetable or synthetic active substances are chosen from immunoglobulins, chemotherapeutics or antibiotics.

54. A method for achieving hemostasis comprising applying a fibrin adhesive preparation to an area in need thereof, wherein the fibrin adhesive preparation comprises a fibrin adhesive as claimed in claim 25.

55. A method for healing a wound in surgery comprising applying a fibrin adhesive preparation to an area in need thereof, wherein the fibrin adhesive preparation comprises a fibrin adhesive as claimed in claim 25.

56. A method for effecting tissue therapy comprising applying a fibrin adhesive preparation to an area in need thereof, wherein the fibrin adhesive preparation comprises a fibrin adhesive as claimed in claim 25.

57. A method for preparing a support medium for one or more biological factors comprising mixing said one or more biological factors with a fibrin adhesive preparation, wherein the fibrin adhesive preparation comprises a fibrin adhesive as claimed in claim 25.

58. The method in accordance with claim 54, wherein the preparation is chosen from a wound care fleece, a bandage, a plaster, a salve, or gel-type preparation.

REMARKS

Claims 1-24 have been cancelled. After entering this amendment, claims 25-58 are pending. Claims 25-58 have been added to place the claims in better conformity with U.S. Patent practice. Support for new claims 25-58 can be found in original claims 1-24. Therefore, no issue of new matter is raised. Accordingly, Applicants respectfully request reconsideration and examination of this application and timely allowance of the pending claims.

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If there is any fee due in connection with the filing of this Preliminary Amendment, please charge the fee to our Deposit Account No. 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

By: Carol P. Einaudi
Carol P. Einaudi
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Date: June 21, 2001

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Fibrin adhesive granulate and method for its preparation

The object of the invention is a flowable fibrin adhesive granulate that contains all substances required for the formation of a stable fibrin gel and can be used directly for wound adhesion. It is generated by spray drying in a fluidized bed by means of a fluidization gas.

It is known that after the creation of a wound, wound healing is initiated through an activation cascade of several subsequent coagulation factors. This finally leads to the reaction between the activated thrombin and fibrinogen in the presence of calcium ions to form a fibrin matrix that covers the wound and thus leads to hemostasis. Said fibrin matrix is further strengthened by the activated Factor XIII (F XIIIa) through additional covalent bonds, which increases the mechanical stability of said fibrin matrix and makes it resistant to premature proteolytical degradation.

In modern surgery, hemostasis continues to gain in significance because of fibrin adhesion and because so-called fibrin adhesives are a well tolerated biomaterial that promotes wound healing. The method is excellently suited for the hemostasis of strongly bleeding wounds during surgery on parenchymatous inner organs, skin transplants, in emergency surgery for internal and external injuries, but primarily also as a supporting seal for sutures to avoid postoperative bleeding. In ear, nose and throat surgery and facial surgery, fibrin adhesive is preferred to sutures for cosmetic reasons for the healing of external wounds. Fibrin adhesive is also used increasingly in endoscopic surgery, for example to arrest bleeding in stomach ulcers.

In addition to inorganic salts and amino acids, the currently available commercial fibrin adhesives such as Beriplast® also contain the coagulation factors fibrinogen, thrombin and Factor XIII, which are obtained from human plasma, as well as albumin

and fibronectin to promote wound healing. Although the preparation exhibits good biochemical and haemostatic properties, it requires extensive preparations prior to use. The separate fibrinogen- and thrombin lyophilisates are dissolved separately, drawn into two separate syringes, and clamped into a special holding device. This process is time-consuming and requires specially trained personnel. A variant of the fibrin adhesive is already commercially available in dissolved form in the syringes under the name Tissucol®, but it can be stored only at low temperatures of -20 °Celsius and requires defrosting in a water bath prior to use. Thus, both variants of the fibrin adhesive cannot be used in situations that call for a ready-to-use fibrin adhesive that does not require advance preparation. Furthermore, a ready-to-use and easily dosable fibrin adhesive would be more economical simply because it would avoid needless preparations or the discarding of excess material.

A possible improvement in the handling of the fibrin adhesive could be a one-component-adhesive that contains all components necessary for the formation of the fibrin in one compartment. However, the development of a one-component adhesive in an aqueous solution is extremely difficult to realize in practice. The only possibility may be to mix the components of the fibrin glue in dry condition so they would dissolve in the blood fluid or the wound exudate after being applied to the wound and then form a fibrin matrix in situ, which would lead to hemostasis. This would also require transforming the fibrinogen, which by nature does not dissolve easily, into a dry form from which it would dissolve quickly while at the same time immediately reacting with the thrombin.

There have also been attempts to use a specific lyophilisation process to develop particles containing fibrinogen and thrombin, which are mixed after preparation and activated in the wound. Thus, international patent application WO 97/44015 describes the preparation of so-called micro particles on which fibrinogen and

thrombin are spray-dried individually. Over 90 % of said particles have a grain size of up to 20 µm. They should dissolve well and can be mixed and used for wound healing. However, a disadvantage of said micro particles is that they form a very dusty powder, which makes a direct application to the wound impossible. Thus, a powder of this type requires a special application system, which drastically reduces its handling and clinical indications.

The problem was therefore to develop a fibrin adhesive granulate that dissolves well, is flowable, is not dusty, and can therefore be applied directly to the wound, for example, in the principle of a salt shaker.

The problem is solved in accordance with the invention by a flowable fibrin adhesive granulate containing thrombin, Factor XIII, fibrinogen and a calcium salt in pellets with a particle size of more than 50 to approximately 1000 µm, preferably with a particle size of 100 to 200 µm. Because of the particle size, the fibrin adhesive in accordance with the invention is not dusty, dissolves well, is flowable, and is excellently suited for application to a wound surface or moist tissue, where it immediately forms a fibrin matrix.

Albumin, fibronectin, amino acids and physiologically safe inorganic salts can be added to a fibrin adhesive granulate of this type. Furthermore, it can also be used as a release system for biological, vegetable and/or synthetic factors. These factors can support wound healing or act as antifibrinolytic, antibiotic, chemotherapeutic, or immune modulators. They are added to the fibrin adhesive granulate during the spray drying process.

An appropriate principal method for the preparation of the fibrin adhesive granulate in accordance with the invention is already known from the international patent application WO

96/15849, which describes a method for the drying of blood plasma, blood plasma fractions, or blood plasma products obtained therefrom, where the treatment product is sprayed in liquid or dissolved condition into an evacuatable container which performs the drying - up to granulate form - by means of a fluidization gas in a fluidized bed. However, this method cannot be readily applied to fibrinogen and thrombin because it is known that these substances react to fibrin after coming into contact with aqueous solutions. Therefore, the use of aqueous solutions is not an option for the spray drying of these components. To obtain both components in one particle nevertheless, the components in accordance with the invention are suspended together in one single organic solvent and spray dried from it. Fibrinogen, thrombin and Factor XIII can also be more or less homogeneously suspended in organic solvents such as the lower alcohols, preferably isopropanol or ethanol, acetone, nitrilene, liquid carboxylic acid esters, ethers, chloroform, dimethyl formamide and dimethyl sulfoxide, also in the presence of $CaCl_2$, without exhibiting a reaction to fibrin. After the organic solvent is removed, they are again capable of fibrin formation in the aqueous phase.

In accordance with the invention, spray drying is performed either with a top-spray-process, where the liquid is supplied to the fluidization gas in the counter current, or in co-current flow (bottom-spray-process). A fine distribution is achieved by spraying the liquid treatment product into the evacuatable container through an appropriate nozzle. In this way, the fluidization gas swirls the product to be treated and also transfers heat. For this reason, a heated gas is used as fluidization gas. Gentle drying can be maintained by measuring the product temperature during the fluidization bed process controlling the process on the basis of said measurements. Either air or an inert gas such as nitrogen can be used as a fluidization gas. The drying is continued until the treatment product is available in finely dispersed granulate form with a

particle size of 50 to approximately 1000 µm, preferably 100 to 200 µm.

The fibrin granulate adhesive in accordance with the invention can be produced in the evacuatable container with or without a support medium as a receiver. Appropriate support media are primarily sugar and sugar alcohols such as saccharose, lactose or mannitol, which have a good bio-tolerance. However, it is also possible to use proteins such as serum albumin as a support medium. It is especially preferred to use the fibrin adhesive component itself, i.e., fibrinogen, Factor XIII, thrombin, $CaCl_2$ or their mixtures, in powder condition as a support medium. The aqueous solution or suspension of the fibrin adhesive component in organic solvent is then sprayed onto said support medium to form a granulate. This makes obsolete the addition of a further support medium such as a sugar, mannitol or albumin.

An especially preferred method is two-phase spray drying where a fibrinogen granulate is prepared first. In addition to fibrinogen, said granulate can also contain other proteins, carbohydrates, amino acids and physiologically safe inorganic salts, and also calcium salt as well. The particle size of said granulate is more than 50 and up to approximately 1000 µm, with the preferred particle size being between 100 and 200 µm. A fine thrombin suspension in an organic solvent is sprayed onto said fibrinogen granulate. Said thrombin suspension can comprise dissolved calcium ions unless they were added already to the fibrinogen granulate. The concentration of the calcium ions is 1 to 100 mM, preferably 10 to 50 mM. This yields a fibrin adhesive granulate with a particle size that is preferably between 100 and 200 µm and has a grainy structure that dissolves very well. This does not yield any compact particles such as small pellets, but rather a granulate with many tiny channels. In this way, it is possible to obtain a relatively large particle size, which renders the product simultaneously free of dust and is very soluble, similar to the known instant coffee. This granulate is

also excellently suited to be applied to a wound surface and immediately forms a solid and elastic fibrin gel after it comes into contact with an aqueous medium.

The fibrin adhesive granulate in accordance with the invention can also be obtained by spray-drying fibrinogen concentrate from an aqueous solution on a receiver, such as mannitol.

To that end, a fibrinogen/mannitol-granulate is obtained first, and then thrombin/calcium salt, for example from an isopropanolic suspension, is sprayed onto said granulate. The organic solvent prevents the formation of fibrin following the contact between fibrinogen and the thrombin.

Finally, it is also possible to prepare separate fibrinogen- and thrombin granulates with the aforementioned particle size in separate processes, whereby both substances can be spray-dried from aqueous solutions. However, for the preparation of the thrombin granulate, this would require a sufficient portion of a support medium because the quantity of thrombin in the fibrin adhesive is smaller by a factor of 10^2 to 10^3 than the quantity of fibrinogen. The two granulates are then mixed and can be used appropriately for hemostasis and wound healing.

The fibrinogen adhesive granulates prepared in accordance with the aforementioned method were then tested as to their biomechanical properties and the following results were obtained:

Tear strength following in vitro tissue gluing (adhesion surface: 2.25 cm^2)

Results of a comparative study based on a randomization list on the tear strength of the uniform granulate (thrombin, fibrinogen and Factor XIII in one particle), the granulate mixture

(fibrinogen granulate + thrombin granulate) and the fluid fibrin adhesive (Beriplast®):

Test substance	Tear Strength
Uniform granulate (mixed granulate)	3.3 N
Granulate mixture	1.8 N
Beriplast®	1.5 N

The measured values clearly show the advantage of the uniform granulate (mixed granulate) compared to the granulate mixture with respect to the biomechanical properties. The quantity of active components was nearly identical in all three testing substances.

Additionally, the fibrin adhesive granulate in accordance with the invention can be stored at room temperature as well as at temperatures of 2 - 8 °Celsius for at least 6 to 8 months without any noticeable loss of activity in the individual components.

The flowable fibrin adhesive granulate in accordance with the invention distinguishes itself from the previously known fibrin adhesives in that it is easier to handle, does not require any preparatory measures and is always in a ready-to-use condition. It is therefore particularly suitable for emergency surgery. It also has the advantage of an extraordinarily simple use in that it can be applied to wound surfaces in the same way as using a saltshaker. It is excellently suited for surgical applications where the objective is to achieve a quick hemostasis by soaking up blood with simultaneous fibrin adhesion.

Although the aforementioned granulates simplify the use of the fibrin adhesive significantly and reduce high-effort surgery preparations that require specially trained personnel and

appropriate devices, there is a continued demand for simple fibrin adhesive preparations that should be in every physician's emergency bag and can be used immediately at the site of an accident without lengthy preparations.

It was possible to find a solution for this problem by developing an effervescent granulate or an effervescent powder to generate a foam that is suitable for hemostasis and contains the substances required for the formation of CO_2 in addition to the granulate mixture or mixed granulate according to the invention containing fibrinogen, Factor XIII, thrombin and a soluble calcium salt.

In addition to many other advantages, the effervescent granulate or effervescent powder in accordance with the invention also has the advantage of loosening up the granulate mass through the foaming, which allows the liquid easier access into the interior of the granulate pellets. This leads quite quickly to the creation of stable fibrin foam that covers the bleeding wound and quickly arrests the bleeding. The formation of the foam can take place directly on the wound, with the wound secretions providing the moisture needed to create the foam. It is also possible, though, to create the foam in a dish or on a plate by adding liquid, and then placing the finished foam on the bleeding wound. Because of its tremendous flexibility, the foam created in this way cannot only be used for the external covering of wounds, but also for bleeding wounds during surgery, where the foam is packed into the bleeding surgery wound and places itself on the bleeding tissue to quickly arrest the bleeding.

There is room for further improvement in the therapeutic value of the effervescent granulate or effervescent powder in accordance with the invention if biological, vegetable or synthetic active substances that promote wound healing, such as immunoglobulins, chemotherapeutics or antibiotics, are added to

said effervescent granulate or powder. These substances are sprayed on the flowable, dry fibrin adhesive granulate during the production of the granulate or the effervescent powder or are mixed therewith. It is also possible to make an effervescent tablet from said mixture, which contains the ingredients for the preparation of a foam that is suitable for hemostasis in a form that is in a precise dosage and easy to handle.

It is generally sufficient to apply the effervescent granulate or effervescent powder in accordance with the invention in a quantity that contains, depending of the size of the bleeding wound, fibrinogen in a quantity of 0.1 to 2.5 grams and thrombin in a quantity of less than 10 I.E. If an effervescent tablet is used, said tablets can also have imprinted breaking grooves that allow breaking off part of a tablet to arrest bleeding in smaller wounds if the quantity of foam generated with part of the tablet is already sufficient to arrest the bleeding.

In addition, the granulate mixtures or mixed granulates in accordance with the invention can also be used to produce galenic preparations that are excellently suited for hemostasis, can be used in a very simple manner, and are available immediately at the site of an accident without requiring lengthy preparations.

This objective is achieved with a biodegradable wound fleece that is able to arrest bleeding even on larger wound surfaces. To that end, a fibrin adhesive granulate is applied, either directly or in combination with a biocompatible auxiliary, to a support medium that is comprised of a biodegradable polymer in which the fibrin adhesive is embedded. A suitable support medium for this purpose is primarily natural or chemically modified collagen, keratin, gelatin, carbohydrates or cellulose derivatives. The support medium can also be comprised of a synthetic, biodegradable polymer. Suitable polymers include polyhydroxy carboxylic acids, polyesters, polycyanoacrylate,

polyaminoacids, polyalcohols as well as silicon. A preparation is applied to said support medium which preferably contains fibrinogen in a quantity of 0.05 to 50 mg/cm^2, preferably 1 to 20 mg/cm^2, as well as thrombin in a quantity of 1 µg to 10 mg/cm^2, preferably 0.05 to 2 mg/cm^2. To improve adhesion, polyethylene glycol (PEG) with a suitable molecule size or a mixture of several polyethylene glycols of various molecule sizes can be added to the fibrin adhesive preparation as auxiliaries.

A further improvement in hemostasis can be achieved by applying the aforementioned wound care fleece to a bandage or plaster bandage. Said bandage should be coated with a wound care fleece in accordance with the invention on the side that will be applied to the bleeding wound. Polyethylene glycol 4000 or polyethylene glycol 6000 or mixtures thereof are preferably used for the preparation of the bandages in accordance with the invention. To prepare the coating, the polyethylene glycol is dissolved in an organic solvent, preferably isopropanol, which is used in a concentration of 0.5 to 70 %, preferably in a concentration of 5 to 30 % (w/v). The fibrin adhesive granulate is spread on the bandage and then wetted with the isopropanol-polyethylene glycol 6000-solution. After the organic solvent has evaporated, the resulting biodegradable wound care fleece has a fibrin adhesive coating with good adhesion. The organic solvent is excellently suited for the coating because it evaporates easily, prevents a reaction with fibrin and ensures that the activity of the individual components is maintained. Furthermore, the granulate form is maintained after treatment in the organic solvent, preferably isopropanol.

The aforementioned, haemostatic, salve- or gel-type preparation is generally applied only to one side of the wound care fleece in accordance with the invention. However, there are application cases where it is preferable to coat both sides of the wound care fleece. If the wound is covered with this type of bandage,

the haemostatic effect of the fibrin adhesive will unfold directly on the wound as soon as the fibrin is formed from the action of the wound secretion and the components in the bandage. In many cases, the application can be simplified further by applying the wound care fleece in accordance with the invention to a waterproof or water-permeable surface material suitable for plaster preparation, whereby room is left on the side for adhesive strips that are coated with a physiologically safe adhesive. This type of plaster can be used quickly and permanently to cover the bleeding wound in a simple way und leads to a quick hemostasis.

Hemostasis can also be achieved in a simple way by embedding the particles of a fibrin adhesive into a salve- or gel-type preparation comprised of a hydrophilic, non-aqueous salve base. Especially suitable for a hydrophilic, non-aqueous salve base are polyols, for example polyethylene glycols, polypropylene glycols or ethylene propylene copolymers in which the particles of the fibrin adhesive are evenly distributed and which take up the moisture contained in the wound secretions. Once moisture enters, the components of the fibrin adhesive immediately form a fibrin mesh that quickly and effectively covers the wound and arrests the bleeding. It is obvious that salve bases that contain fats or are water-repellent are not suitable for this use.

The fibrin adhesive contained in the preparations in accordance with the invention contains a dry mixture of fibrinogen, Factor XIII, thrombin and a soluble calcium salt. The preparation can be also appropriately filled into a salve tube and can then be stored over a long period of time and readily used in this form.

It goes without saying that the effectiveness of the aforementioned preparations to achieve hemostasis is guaranteed only if any addition of aqueous fluids and thus a premature formation of fibrin is avoided prior to their use. This must

also be taken into account during the production of the preparations, when the granulate mixtures or the mixed granulates in accordance with the invention are impasted with the hydrophilic, but non-aqueous salve-base in the known manner. The salve- or gel-type preparation obtained in this way can then be applied to the biodegradable support medium to prepare a wound care fleece, or it can be used directly.

A further improvement of the preparations in accordance with the invention can be achieved if other biological, vegetable or synthetic active substances such as immunoglobulin, chemotherapeutics, or antibiotics are added in addition to the fibrin adhesive.

The wound care fleece in accordance with the invention, the bandage or plaster, or the salve- or gel-type preparation can be used in a simple and effective manner for the hemostasis of interior and exterior wounds.

The invention is explained by the following examples.

Example 1

Preparation of fibrinogen granulate without support medium as receiver

A 10 % protein solution of Beriplast®-fibrinogen concentrate (also contains F XIII) was spray dried according to the top-spray-method in a fluidized bed. Said process was performed in a GPCG 1-facility by Glatt GmbH and is claimed and described in detail in International Patent Application WO 96/15849. The conditions were:

Input temperature:	37 °Celsius
Output temperature:	30 °Celsius
Spraying pressure:	3.0 bar

Spraying rate: 3.2 g/min

The fibrinogen granulate prepared in this way had a mean particle size of 100 µm and dissolved very well. Analytical measurements of the activity showed that the activity of fibrinogen and F XIII was not negatively affected by the spray drying process under the aforementioned conditions.

Example 2

Preparation of fibrinogen granulates with support medium as receiver

200 grams of mannitol or albumin was placed in the spray-drying chamber. 100 grams of fibrinogen concentrate was sprayed on the receiver in the fluidized bed under the following conditions:

Input temperature: 30 °Celsius
Output temperature: 24 °Celsius
Spraying pressure: 2.5 bar
Spraying rate: 3.0 to 8.0 g/min

The resulting granulate was flowable, dissolved very well, and had a mean particle size of 100 µm, with full recovery of the fibrinogen- and F XIII activity.

Example 3

Preparation of fibrin adhesive granulate

An isopropanolic thrombin/$CaCl_2$-suspension was sprayed on the fibrinogen granulate prepared in Examples 1 or 2. The process conditions were as follows:

Input temperature: 30 °Celsius
Output temperature: 25 °Celsius

Spraying pressure: 2.5 bar
Spraying rate: 3.0 to 8.0 g/min

The fibrin adhesive granulate prepared in this manner had a mean particle size of 100 µm; it was flowable, did not give off dust, immediately formed a stable fibrin coagulum after coming into contact with an aqueous solution, and was rendered covalent by F XIII.

Example 4

Preparation of thrombin granulate

An aqueous 0.3 % thrombin solution was sprayed on a mannitol or human serum albumin receiver. The conditions were as follows:

Input temperature: 30 °Celsius
Output temperature: 23 °Celsius
Spraying pressure: 2.5 bar
Spraying rate: 4.2 g/min

The resulting granulate had a mean particle size of approximately 65 µm; it was flowable and did not give off dust. It mixed well with the fibrinogen granulate and was also suitable for use as fibrin adhesive.

Example 5

Preparation of a fibrin adhesive granulate from an isopropanolic suspension containing all fibrin adhesive components

An isopropanolic suspension containing all fibrin adhesive components, i.e., fibrinogen, Factor XIII, thrombin, $CaCl_2$ or mixtures thereof, was sprayed into a spray-drying chamber according to Examples 1 and 2, which contained either no support medium at all or a support medium such as mannitol, albumin or

one or more powdered fibrin adhesive components, and then spray-dried in the fluidized bed. The process was performed under the following conditions:

Input temperature:	30 °Celsius
Output temperature:	25 °Celsius
Spraying pressure:	2.5 bar
Spraying rate:	3.0 to 8.0 g/min

The fibrin adhesive granulate prepared in this manner had a mean particle size of approximately 100 µm; it was flowable, did not give off dust, and immediately formed a stable, cross-linked fibrin coagulum after coming into contact with an aqueous solution.

Example 6

Preparation of a biodegradable bandage coated with fibrin adhesive

250 mg fibrin adhesive powder or granulate was placed on a 50 x 50 mm^2 Type 6 Ethisorb® patch (Ethicon GmbH) and distributed evenly (= 10 mg fibrin adhesive powder or granulate per cm^2). Then a total of 2.5 ml of a solution of isopropanol/20 % PEG 6000 was sprayed evenly on the coating. The biodegradable bandage obtained after the evaporation of the isopropanol was comprised of a support medium and fibrin adhesive coating with good adhesion and did not crumble after bending.

Example 7

Preparation of a biodegradable bandage coated with fibrin adhesive

60 mg fibrin adhesive powder or granulate was applied to a 20 x 30 mm^2 Type 6 Vicryl-fleece (Ethicon GmbH) and spread evenly (=

10 mg powder per cm^2). Then a total of 0.6 ml of a solution of isopropanol/20 % PEG 6000 was sprayed evenly on the coating. After the isopropanol had evaporated, a flexible, biodegradable bandage with a fibrin adhesive coating and good adhesion was obtained.

Example 8

Collagen fleece coated with fibrin adhesive

The Interceed collagen fleece (Johnson & Johnson), size 50 x 50 mm^2, was mixed evenly with 250 mg fibrin adhesive powder or granulate. Then a total of 0.6 ml of a solution of isopropanol/10 % PEG 6000 was sprayed evenly on the coating. After the isopropanol had evaporated, a combined fibrin adhesive collagen fleece was obtained.

Patent Claims

1. Flowable fibrin adhesive granulate, characterized in that it has granulate pellets with a particle size of over 50 to approximately 1000 µm which contain thrombin, Factor XIII, fibrinogen and a calcium salt.

2. Fibrin adhesive granulate in accordance with claim 1, characterized in that the granulate pellets have a particle size of 100 to 200 µm.

3. Fibrin adhesive granulate in accordance with claims 1 and 2, characterized in that it also contains albumin, fibronectin, and/or other substances that promote wound healing.

4. Effervescent granulate or effervescent powder to generate a foam suitable for hemostasis, characterized in that in addition to the flowable fibrin adhesive granulate of claims 1 to 3, it also contains the substances required for the formation of CO_2.

5. Effervescent granulate or effervescent powder in accordance with claim 4, characterized in that it contains a mixture of a carbonate and a physiologically safe organic acid for the formation of CO_2.

6. Preparation to arrest bleeding, characterized in that it contains a wound care fleece comprised of a biodegradable support medium which is coated with a flowable fibrin adhesive granulate of the claims 1 to 3.

7. Preparation in accordance with claim 6, characterized in that the wound care fleece is coated with a hydrophilic, non-aqueous salve base and that the fibrin adhesive of claims 1 to 3 is embedded in said salve base.

8. Wound care fleece in accordance with claims 6 and 7, characterized in that the biodegradable support medium is comprised of natural or chemically modified collagen, keratin, gelatin, carbohydrates or cellulose derivatives.

9. Wound care fleece in accordance with claims 6 and 7, characterized in that the biodegradable support medium is comprised of a polymer from the group of the polyhydroxy carboxylic acids, the polyesters, the polycyano acrylates, the polyamino acids, the polyalcohols or the silicones.

10. Wound care fleece in accordance with claims 6 to 9, characterized in that it contains fibrinogen in a quantity of 0.05 to 50 mg/cm^2 and thrombin in a quantity of 1 µg to 20 mg/cm^2.

11. Wound care fleece in accordance with claims 6 to 10, characterized in that the preparation containing the fibrin adhesive is applied to one or both sides of the support medium.

12. Bandage, characterized in that it is coated with a wound care fleece in accordance with claims 6 to 11 at the location that will be applied to the bleeding wound.

13. Plaster, characterized in that it is comprised of a water-proof or water-permeable surface material that is coated with a would care fleece in accordance with claims 6 to 11 at the location that will be applied to the bleeding wound and has adhesive surfaces at the edges.

14. Preparation to arrest bleeding, characterized in that it is comprised of a hydrophilic, non-aqueous salve base into which the particles of a fibrin adhesive in accordance with claims 1 to 3 are embedded.

15. Method for the preparation of the fibrin adhesive granulate in accordance with claims 1 to 3, characterized in that all components of the fibrin adhesive are suspended in an organic solvent and are spray-dried in an evacuatable container by means of a fluidization gas in the fluidized bed up to a particle size of more than 50 to 1000 µm, preferably 100 to 200 µm.

16. Method in accordance with claim 15, characterized in that it is prepared with or without a support medium placed into the container as receiver.

17. Method for the preparation of a fibrin adhesive in accordance with claims 1 to 3, characterized in that a fibrinogen granulate is prepared first, and that a suspension of an organic solvent containing thrombin is sprayed onto said fibrinogen granulate, whereby a calcium salt is added either to the fibrinogen granulate or to the thrombin solution.

18. Method for the preparation of a fibrin adhesive granulate in accordance with claims 1 to 3, characterized in that the separately prepared fibrinogen- and thrombin granulate pellets, each of which have a particle size of more than 50 µm to approximately 1000 µm, are mixed with one another.

19. Method for preparing a preparation in accordance with claims 6 to 14, characterized in that the fibrin adhesive, which is available as a granulate mixture or as mixed granulate, is layered on a biodegradable support medium.

20. Method for preparing the preparation in accordance with claim 14, characterized in that a fibrin adhesive that is available as a granulate mixture or as mixed granulate is impasted with the hydrophilic, non-aqueous salve base.

21. Method for preparing a preparation in accordance with claims 6 to 14, characterized in that other biological, vegetable or synthetic active substances such as immunoglobulins, chemotherapeutics or antibiotics, which promote wound healing, are added to the fibrin adhesive granulate.

22. Use of a fibrin adhesive granulate in accordance with claims 1 to 5 or a preparation in accordance with claims 6 to 14, characterized in that it is used for wound healing in surgery, tissue therapy, and/or as support medium for biological factors.

23. Use of the wound care fleece, the bandage, the plaster or the salve or gel-type preparation in accordance with claims 6 to 14 for the hemostasis of interior or exterior wounds.

24. Use of an effervescent granulate or an effervescent powder in accordance with claims 4 and 5 for the preparation of an effervescent pressed tablet.

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that: My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

FIBRIN-BASED GLUE GRANULATE AND CORRESPONDING PRODUCTION METHOD

the specification of which:

is attached hereto; or

was filed as United States Application Serial No. 09/869,031
on June 22, 2001, and was amended on June 22, 2001
(if applicable); or

was filed as PCT International Application Number PCT/EP99/06898
on September 17, 1999 and was amended on _____
(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT international application(s), designating at least one country other than the United States, listed below and have also identified below any foreign application(s) for patent or inventor's certificate, or any PCT international application(s) having a filing date before that of the application(s) of which priority is claimed:

Country	Application Number	Date of Filing	Priority Claimed Under 35 U.S.C. 119
Germany	198 59 611.1	December 23, 1998	X YES ☐ NO
Germany	199 28 372.9	June 21, 1999	X YES ☐ NO
Germany	199 28 371.0	June 21, 1999	X YES ☐ NO

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

Application Number	Date of Filing

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) or § 365(c) of any PCT international application(s) designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application(s) in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

Application Number	Date of Filing	Status (Patented, Pending, Abandoned)

I hereby appoint the following attorney and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. **FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P., Reg. No. 22,540**, Douglas B. Henderson, Reg. No. 20,291; Ford F. Farabow, Jr., Reg. No. 20,630; Arthur S. Garrett, Reg. No. 20,338; Donald R. Dunner, Reg. No. 19,073; Brian G. Brunsvold, Reg. No. 22,593; Tipton D. Jennings IV, Reg. No. 20,645; Jerry D. Voight, Reg. No. 23,020; Laurence R. Hefter, Reg. No. 20,827; Kenneth E. Payne, Reg. No. 23,098; Herbert H. Mintz, Reg. No. 26,691; C. Larry O'Rourke, Reg. No. 26,014; Albert J. Santorelli, Reg. No. 22,610; Michael C. Elmer, Reg. No. 25,857; Richard H. Smith, Reg. No. 20,609; Stephen L. Peterson, Reg. No. 26,325; John M. Romary, Reg. No. 26,331; Bruce C. Zotter, Reg. No. 27,680; Dennis P. O'Reilley, Reg. No. 27,932; Allen M. Sokal, Reg. No. 26,695; Robert D. Bajefsky, Reg. No. 25,387; Richard L. Stroup, Reg. No. 28,478; David W. Hill, Reg. No. 28,220; Thomas L. Irving, Reg. No. 28,619; Charles E. Lipsey, Reg. No. 28,165; Thomas W. Winland, Reg. No. 27,605; Basil J. Lewris, Reg. No. 28,818; Martin I. Fuchs, Reg. No. 28,508; E. Robert Yoches, Reg. No. 30,120; Barry W. Graham, Reg. No. 29,924; Susan Haberman Griffen, Reg. No. 30,907; Richard B. Racine, Reg. No. 30,415; Thomas H. Jenkins, Reg. No. 30,857; Robert E. Converse, Jr., Reg. No. 27,432; Clair X. Mullen, Jr., Reg. No. 20,348; Christopher P. Foley, Reg. No. 31,354; John C. Paul, Reg. No. 30,413; David M. Kelly, Reg. No. 30,953; Kenneth J. Meyers, Reg. No. 25,146; Carol P. Einaudi, Reg. No. 32,220; Walter Y. Boyd, Jr., Reg. No. 31,738; Steven M. Anzalone, Reg. No. 32,095; Jean B. Fordis, Reg. No. 32,984; Barbara C. McCurdy, Reg. No. 32,120; James K. Hammond, Reg. No. 31,964; Richard V. Burgujian, Reg. No. 31,744; J. Michael Jakes, Reg. No. 32,824; Dirk D. Thomas, Reg. No. 32,600; Thomas W. Banks, Reg. No. 32,719; Christopher P. Isaac, Reg. No. 32,616; Bryan C. Diner, Reg. No. 32,409; M. Paul Barker, Reg. No. 32,013; Andrew Chanho Sonu, Reg. No. 33,457; David S. Forman, Reg. No. 33,694; Vincent P. Kovalick, Reg. No. 32,867; James W. Edmondson, Reg. No. 33,871; Michael R. McGurk, Reg. No. 32,045; Joann M. Neth, Reg. No. 36,363; Gerson S. Panitch, Reg. No. 33,751; Cheri M. Taylor, Reg. No. 33,216; Charles E. Van Horn, Reg. No. 40,266; and Linda A. Wadler, Reg. No. 33,218; Jeffrey A. Berkowitz, Reg. No. 36,743; Michael R. Kelly, Reg. No. 33,921; James B. Monroe, Reg. No. 33,971; Doris Johnson Hines, Reg. No. 34,629; Allen R. Jensen, Reg. No. 28,224; Lori Ann Johnson, Reg. No. 34,498; and David A. Manspeizer, Reg. No. 37,540 and _____. Please address all correspondence to **FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.**, 1300 I Street, N.W., Washington, D.C. 20005, Telephone No. (202) 408-4000.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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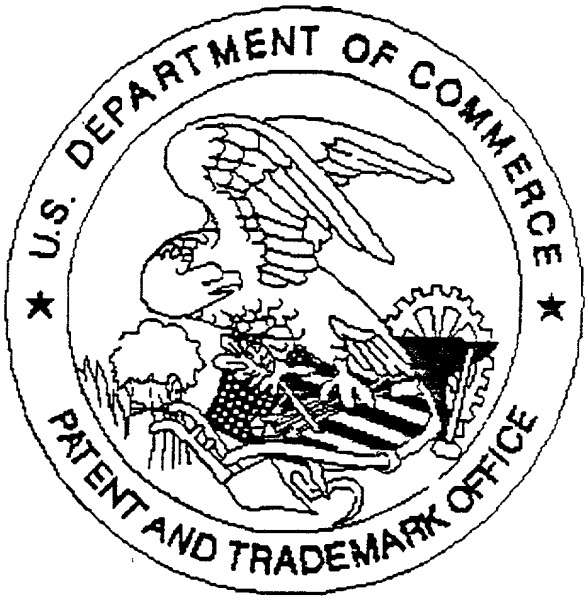

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